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The invention refers to a Aufsprüh or evaporator with a planar Magnetron, in particular to a evaporator for applying a thin film to a rectangular, preferably endless, bandförmiges material such as films, courses, fibers and glass by evaporating or Aufstäuben, so that the thin film receives a homogeneous thickness.

From the JA-A-59-22 788 already a evaporator with a circular electromagnetic coil is well-known. During this evaporator however the difficulty exists that during continuing coating of a bandförmigen material mi by Aufstäuben the thin film receives a convex cross section to a thin film toward the width of the bandförmigen material, whereby the maximum thickness in the center the width of the bandförmigen material is present.

The invention is the basis the task to indicate a evaporator as a planar Magnetron with which it is possible to apply on a bandförmiges material continuously a thin film whose thickness is even toward the width of the bandförmigen material and over the entire bandförmige material. Furthermore a evaporator is to be indicated as small dimensions, with which it is possible, which coated effective width one with a up-made dust material bandförmigen material increase.

For the solution of the first task according to invention a evaporator with planar Magnetron is intended, which contains several magnetic field generation mechanisms, which are so arranged between a yoke planned on a cathode and a target plate that within a spatial range on the target plate a tunnelförnige magnetic field distribution results. Each Magnetfelderzeugungseinrichtu has the form of a rectangular ring; the magnetic field generation mechanisms are concentrically to each other arranged. A current controlling mean for changing at least one that the magnetic field generation mechanisms of supplied rivers serves for the change the size of the plasma ring formed over the magnetic field generation mechanisms.

The size of the plasma ring can be changed in the following way. Becomes by a first electromagnetic coil (i.e. an internal electromagnetic coil) in form of a rectangular ring flowing river constantly held and by second (i.e.) if electromagnetic coil i form of a rectangular ring in same direction as the river of the first coil expresses flowing river increased, then the size of the plasma ring becomes larger. If the river flows by the second coil against the river by first and by the second coil flow river increased, then the size of the plasma ring decreases. The catch or target plate is vaporized locally in the place, where the plasma ring is produced. Therefore those can become evaporating subjected surface of the target plate by varying the size of the plasma ring geände.

Furthermore for the solution of the second task a evaporator with planar Megatron is intended, which contains the following component: A rollenförmige anode swivelling stored in a Vakuumbehälter, several cathodes turned in the Vakuumbehälter arranged and a bandförmigen material whereby the bandförmige material in contact with the rollenförmigen anode, which can be coated with a thin film by evaporating, is held and whereby the cathodes are so arranged that they form either parallel or perpendicularly to the direction of motion of the bandförmigen material a straight line or perpendicularly to the direction of motion of the bandförmigen material a zigzag line. At that the bandförmigen material turned end of each cathode a target plate is fastened, in such a manner that several magnetic field generation mechanisms, which are arranged in a recess of the cathode at of them the bandförmigen material turned end and per the form of a rectangular ring have of the target plate are covered, so that within a spatial range on the target plate a tunnelförmige magnetic field distribution develops.

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The invention is more near described on the basis the remark examples represented in the design. Show:

Fig. 1 the side view of a first execution form of the evaporator according to invention with planar Magnetron,

Fig. 2 the front view of the evaporator of the Fig. 1,

Fig. 3 a block diagram with the circuit design of the evaporator of the Fig. 1 and 2,

Fig. 4 the cross section one with the execution form of the Fig. Magnetrons used 1 to 3,

Fig. 5 the cut V-V of the Fig. 4,

Fig. 6 the cross section of a Magnetrons for a second execution form of the evaporator according to invention with planar Magnetron,

Fig. 7 the cut VII VII the Fig. 6,

Fig. 8 the side view of a third execution form of the evaporator according to invention with planar Magnetron,

Fig. 9 the front view of the evaporator of the Fig. 8,

Fig. 10A, 10B and 10C in the diagram dependence between the distance toward the width of a bandförmigen material and the thickness of a thin film applied on the bandförmige material,

Fig. 11 a diagram with the thickness distribution of a compound thin film,

Fig. 12 the side view of a main part of a fourth execution form of the evaporator according to invention with planar Magnetron,

Fig. 13 the front view in Fig. 12 of main part shown,

Fig. 14A and 14B in the diagram a changed thickness distribution of the separated film due to different conditions of work of the cathode 33 or 34 the Fig. 12 and 13,

Fig. 15 the front view of a main part of a fifth execution form of the evaporator according to invention with planar Magnetron and

Fig. 16 schematically the arrangement of the cathodes with the execution form of the Fig. 15.

On the basis the Fig. 1 to 5 is described a first execution form of the evaporator according to invention with planar Magnetron. Fig. 1 and 2 is a side and/or. Front view of a evaporator, Fig. a block diagram with the circuit design of the evaporator shows 3.

In accordance with Fig. 1 and 2 the evaporator a Vakuumbehälter 1, a pipe 2 contains for the connection of the Vakuumbehälters 1 with (not shown) a vaccum pump, a supply role of 4 to the continuing, endless supply of a course 3, a photograph role of 5 for continuing rolling of the course 3 up, a rollenförmige anode 6, a catch or a target plate 7 and a cathode 8. After Fig. a voltage supply 9 too still serves 3 for the supply of an electrical potential for the cathode 8, a voltage supply 10 for the current supply for describing electromagnetic coils and an automatic controller 11 for the control or regulation of the rivers supplied by the voltage supply 10. The automatic controller 11 contains a digital/similar to (D/A transducers) 12 and a microcomputer 13.

That the microcomputer 13 supplied current signal is converted by the D/A transducer 12 into a similar signal in the range between 0 and 10 V. The supplied current signal appropriate river, steered by a Schalttransistor, one supplies to an electromagnetic coil.

In the following the Aufsprüh or evaporating process is described after the invention.

First the Vakuumbehälter becomes 1 by means of the vaccum pump on a pressure of for instance 1,3x10< - 3> to 0,13x10< - 3> Pa evacuates. Then over (not shown) a gas inlet system argon is introduced into the Vakuumbehälter 1 and brought on a pressure by approximately 0.8 Pa. A river is sent by everyone of the electromagnetic coils arranged under the target plate 7, whose size and direction are stopped in such a way that within a spatial range on the target plate 7 a magnetic field from 200 to 300 G develops. Whereupon the supply role of 4, and the take-up reel 5 are set the rollenförmige anode 6 on, so that itself the course 3 with a speed of 1 m/min. moved. Whereupon between anode 6 and cathode 8 DC voltage is applied from 600 to 700 V, so that in the argon atmosphere a glow discharge develops and forms a plasma range, into which the argon ions is enclosed. The argon ions within plasma range are accelerated by the tension put on and to strike on the surface of the target plate 7 up. Thereby atoms or particles of the target plate 7 from the surface of the target plate 7 are sputtered or evaporate and on the course 3 are separated, which is pressed in slightly against the role anode 6 and moved with this. In this way on the course 3 a thin film from the target material is separated.

On the basis the Fig. 4 and 5 a planar Magnetron with an inside and an outside electromagnetic coil, used in the available execution form, is described, which has ever the form of a rectangular ring.

Fig. a cross section of a planar Magnetrons, Fig shows 4. 5 the cut V-V of the Fig. 4. In Fig. a first, below a middle range arranged coil 14 electromagnetic contains 4 and 5 shown planar Magnetron of the target plate 7 in form of a rectangular ring, a second, outside of the first coil 14 arranged electromagnetic coil 15, likewise in form of a rectangular ring, a cathode 16, a cooling agent channel 17 for water serving for the cooling of the target plate 7, a pipe 18 for cooling water for the first coil 14, a pipe 19 for cooling water for the second coil 15, a coat 20 for the prevention of an unloading in an area outside of the spatial range on the target plate 7, a screen 21 for the prevention of the separation of atoms and particles of the target material on the inside Surface of the Vakuumbehälters 1, a carrier 22 for the Vakuumbehälter 1 and an insulating bush 23. The first and second coil 14 and/or. 15 is magnetically connected by a yoke 24.

For the increase of the life span of the target plate 7 and for the Vergleichmässigung of the thickness of the thin film separated on the course 3 the respective rivers of the first and second coil must be regulated during the evaporating process for example in the following way.

A river of 4 A is sent by the first electromagnetic coil 14 in form of a rectangular ring, which is below a middle range of the target plate 7. By the second electromagnetic coil 15 in form of a rectangular ring, surrounding concentrically the first coil 14, against the direction of current by the first coil 14 a river is sent by likewise 4 A. The river by the second coil 15 is lowered temporally linear on 0 and increased on it temporally linear to 4 A. This decrease and increase of the river are repeated, with which the expansion and contraction of the plasma ring formed on D Magnetron repeat themselves. Thus the corroded range on the target plate becomes 7 compared to a conventional procedure surface-moderately more largely, with which the size of the plasma ring is kept constant. Furthermore a V-shaped groove does not become by sputtering in the surface of the target plate 7, but a flat even groove in an educated manner. Accordingly the volume of the corroded range of the target plate 7 and thus their life span in strong measure are increased. Since furthermore during the atomization process in the surface of the target plate 7 no V-shaped groove develops, the thin film separated on the course 3 receives an even thickness.

If one lets the river of the second coil 15 flow in the same direction as in the first coil the 14 and if one varies it within a range from 0 to 4 A, then the size of the plasma ring varies in the way described above, where the river flows by the second coil against the direction of current of the first coil 14. The size of the plasma ring is however larger, if both rivers flow in the same direction as if it into each other opposite directions flow.

Instead of the river by the second coil 15 after a dreieckförmig running cam shape up and redirecting, it can be changed

also after other courses of the curve, for example for sine or trapezoidally. Furthermore it is favourable to regulate the river of an electromagnetic coil automatically by a microcomputer or a secondary control since such an automatic control is suitable for the continuing coating of a bandförmigen material with a thin film. However if the river is changed within a narrow range, then it can be steered also by hand.

With the planar Magnetron of the Fig. the second coil 15 is concentrically arranged 4 and 5 to the first coil 14 outside of that and. Outside of the second coil 15 several further electromagnetic coils can be arranged, which have likewise in each case the form of a rectangular ring. Thereby the size leaves itself in Fig. 3 plasma ring shown into a wider range change.

As describes, the disadvantages of the state of the art can be avoided by the invention, which is called the life span of the target plate 7 increased and which thickness of a thin film separated on the course 3 comparison-moderates.

On the basis Fig. 6 and 7 a further execution form of a evaporator according to invention with planar Magnetron is described.

Fig. the cut one shows 6 in the above execution form used planar Magnetron, Fig. 7 the cut VII VII the Fig. 6. With the available execution form four electromagnetic coils arranged next to each other serve 26, 27, 28, 29 for the production of a desired magnetic field. As in Fig. shown, between the coil 27 as well as between the coil 28 and the coil 29 a tunnelförmige magnetic field distribution is formed for 6. The planar Magnetron used with the available execution form has large dimensions, so that a large range of the material can be coated at the same time with a thin film.

With the planar Magnetron of the Fig. 6 and 7 is next to each other arranged four coils 26 to 29. A part of these coils can be replaced by a permanent magnet.

Fig. 8 and 9 shows the side and/or. Front view of a further execution form of the evaporator according to invention with planar Magnetron. The execution form of the Fig. the Fig differs 8 and 9 from that. 1 to by the fact 3 that perpendicularly to the direction of motion of the course 3 three cathodes 30, 31 and 32 are arranged.

First it is accepted that only one of the cathodes 30 to 32 is operated. If a Magnetron of the Fig. 4 uses and the respective rivers of the first and second coil 14 and/or. 15 to be in an appropriate way steered, the thin film separated on the course 3 can do in one the Fig. 10A, 10B and 10C thickness distribution shown toward the width of the course 3 have. In detail the thickness distribution of the Fig becomes. 10A obtains, if a cathode with width by 400 mm, a length of 250 mm and a height of 200 mm with a distance between target plate 7 and role anode 6 of 50 mm is used. By the coils 14 and 15 flows in opposite direction of rivers from in each case 4 A. Fig. 10B shows the thickness distribution with a river of 4 A by the first coil 14 and a river of 2 A.Fig, flowing into opposite direction by the second coil 15. 10C shows the thickness distribution with a river of 4 A by the first coil 14 and a river of 1 A., flowing into opposite direction by the second coil 15. How mentions above, different thickness distributions can be obtained by change of the maximum value and/or the direction of the river flowing by the second coil 15.

After Fig. 8 and 9 is three cathodes 30 to 32, in each case with the structure of the arrangement after Fig. 4, perpendicularly to the direction of motion of the course 3 next to each other arranged. The river of the coil fastened to each cathode is stopped in such a way that the thickness distribution of the Fig. 10A by each cathode is received, leaves themselves a thin film from vapour-deposited material from three target plates 30a, 31a and 32a with the compound or overlaid thickness distribution in accordance with Fig. 11 obtain. A thin film separated in a conventional procedure on the course 3 has transverse to width the course 3 a convex thickness distribution, is called a maximum thickness at the center the width of the course 3 and at the two edges of the course 3 a thickness with a value, which lies below a pre-determined value. Thus the effective width of the thin film amounted to 270 mm, i.e. about < 2> /3 the width of a cathode of 400 mm. Of a cathode with width when using 1200 mm the effective width of a thin film laid on on the course amounts to about 800 mm. Against it if the resulting width of the cathodes is 30 to 32 equivalent 1200 mm with the structure according to invention, then becomes in accordance with Fig. 11 the effective width of a separated thin film more than 1000 mm. That is, the effective width of the thin film amounts to < 9> /10 the resulting width of the cathodes 30 to 32. Furthermore according to invention the thickness distribution of one can the Fig. 10A, 10B and 10C with the thickness distribution of another this Fig. are combined, by accordingly steering the river in the cathodes 30 to 32. Here the effective width of the separated thin film can be likewise increased.

With the available execution form the rivers in the cathodes 30 to 32 are varied temporally in such a way that itself a compound thickness distribution in accordance with Fig. 11 results in. Therefore the corroded range of everyone of the target plates 30a, to a narrow range, is not limited 31a and 32a but increases on a broad surface. Thereby the life span of the target plate is increased.

With the available remark example several cathodes, which produce one tunnelförmige magnetic field distribution each, are perpendicularly to the direction of motion of the course 3 next to each other arranged. The rivers in the cathodes are steered in such a way that the thickness distribution of a thin film obtained with one of the cathodes is combined in favorable way rivet of the thickness distribution one with another cathode of produced thin film. Therefore the effective width can do one with the available execution form of the evaporator of production thin film equal < 9> /10 the resulting width of the cathodes to be made. On the other hand the effective width of a separated thin film amounts to < in the conventional procedure; 2> /3 the width of a cathode. Thus the total volume of the cathodes can be decreased with the help of the device according to invention. That is, the evaporator of the execution form described here can be implemented with small dimensions. Furthermore the thickness even with the help of the available execution form of a thin film applied on the course 3 is and local corrosions in each target plate can be prevented. Thus the life span of each target plate can be increased.

On the basis the Fig. 12, 13, 14A and 14B a further execution form of the evaporator according to invention with planar Magnetron is described. Fig. 12 is a side view of a main part of the above execution form, Fig. 13 a front view of the main part, whereby two cathodes 33 and 34 on a straight line parallel to the direction of motion of the bandförmigen material, i.e. the direction of rotation of the role anode 6 in distances from each other arranged are. The Fig. 14A and 14B show the obtained thickness distribution if the distance between role anode 6 and target plate 33a or 34a is equal to 40 mm. The other conditions are the same as the conditions with the achievement of the thickness distribution of the

Fig. 10B.Fig. 14B shows the obtained thickness distribution if between role anode 6 and cathode 33 or 34 a low tension or briefly a normal tension is put on.

If a thin film with the thickness distribution of the Fig. 14A, which was formed by the cathode 33 or 34, on a thin film of the thickness distribution of the Fig. 14B, which was formed by the other cathode, is applied, is superior the resulting thin film regarding the uniformity of the thickness a thin film applied in a conventional procedure regarding the uniformity. Beyond that the effective width of the resulting thin film is larger than a thin film manufactured in the conventional procedure. The available execution form of the evaporator according to invention time thus the same effect as the execution form of the Fig. 1 to 3.

Furthermore by means of the available execution form of the evaporator by the target plate the 33a and the material sputtered by the target plate 34a are deposited successively on a part of the course 3. Therefore the atomization time, which is necessary to obtain a thin film of pre-determined thickness can be shortened compared to a conventional procedure, with which only one cathode is used. Thus the process time shortens.

Furthermore become the procedure the achievement of the thickness distribution of the Fig. 14A and the procedure for the achievement of the thickness distribution of the Fig. 14B alternating and repeats 33 and 34 for each of the cathodes accomplished, then the corroded surface of everyone of the target plates 33a and 34a becomes larger, whereby the life span of each target plate is continued to extend.

Fig. 15 and 16 shows the front view of a main part of a further execution form of a evaporator according to invention with planar Magnetron and/or. a schematic representation of the arrangement of the cathodes with these Ausführungsf

Here the cathodes 35 and 36 are just as arranged as in the Fig. 12 and 13. A cathode 37 is in a position arranged, which lies in the center between the cathodes 35 and 36, however perpendicularly to the direction of motion of the bandförmigen material 3 shifted is. This execution form produces the same effect as those the Fig. 8 and 9.